ATO-P (ASD 100)/ITT SWIM Architecture Development

Jenny Jin –ITT/AES
Tricia Gilbert – ITT/AES
Stephen Henriksen – ITT/AES
Josh Hung -- FAA

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Historical Perspective

- **SWIM Concept was initially conceived in 1997 as NAS Wide Information System (NWIS). The term SWIM was cloned in 1998 in Europe.**
- **ICAO/WMO adopted the SWIM concept in 2002**
- **RTCA published NAS Concept of Operations and Future Vision in 2002 with detailed SWIM objectives**
- **Concept of Use for NAS Wide Information Services was published by ASD-100 in 2002**
- **Many SWIM like prototypes were implemented.**
- **ASD-100 has profound interest in SWIM and has supported**
  - **FAA Communication Architecture development and validation**
  - **SWIM Functional Architecture and Physical Architecture development**

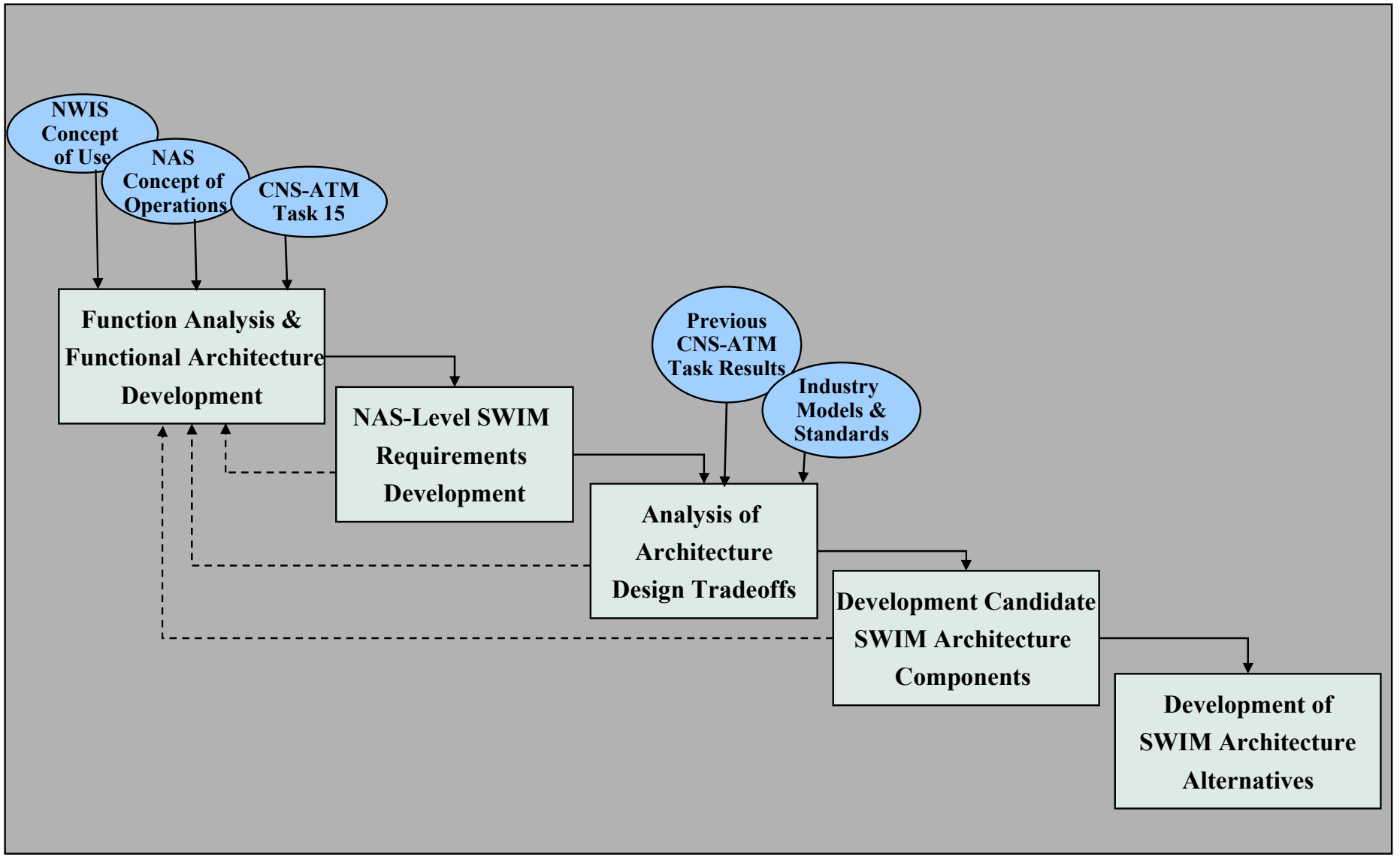
SWIM Objectives

- **Provide a scalable, evolvable, and standards-based solution for global ATM system integration**
- **Allow secure information sharing among ATM systems and applications in real time**
- **Support interoperability among ATM system domains**
- **Built on a telecommunication infrastructure**
  - **FAA Telecommunication Infrastructure (FTI)**
  - **A/G Communication**

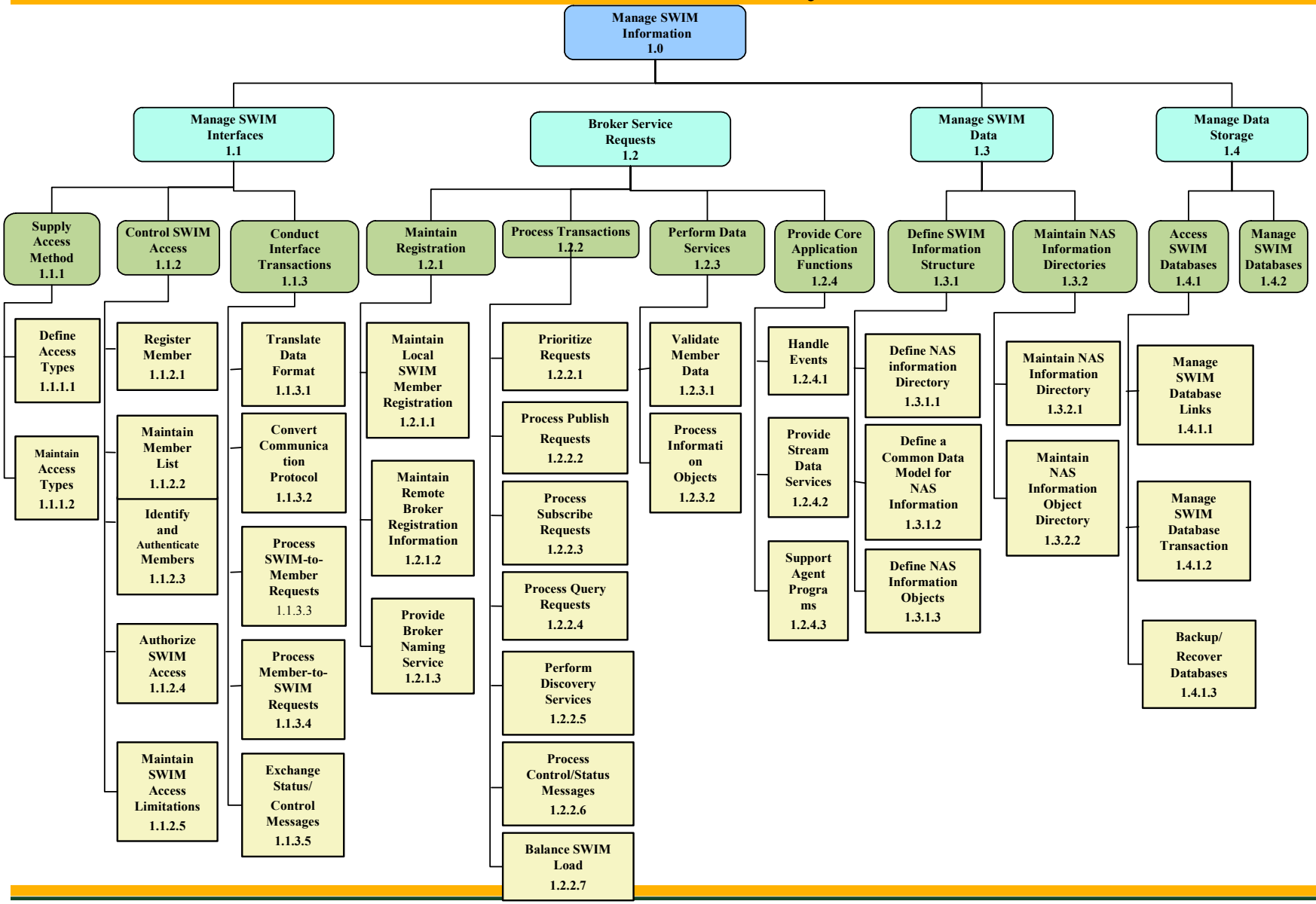
ITT/AES SWIM Architecture Task Activities

- **SWIM Functional Analysis**
  - Completed June 2003
- **SWIM NAS Level Requirements Development**
  - Completed November 2003
- **SWIM Physical Architecture Development**
  - Completed February 2004
- **SWIM Transition Alternatives and Recommendation**
  - Completed March 2004
- **SWIM Architecture Simulation/Validation**
  - Completed March 2004
- **Final Report and Executive Briefings**
  - Completed March 2004

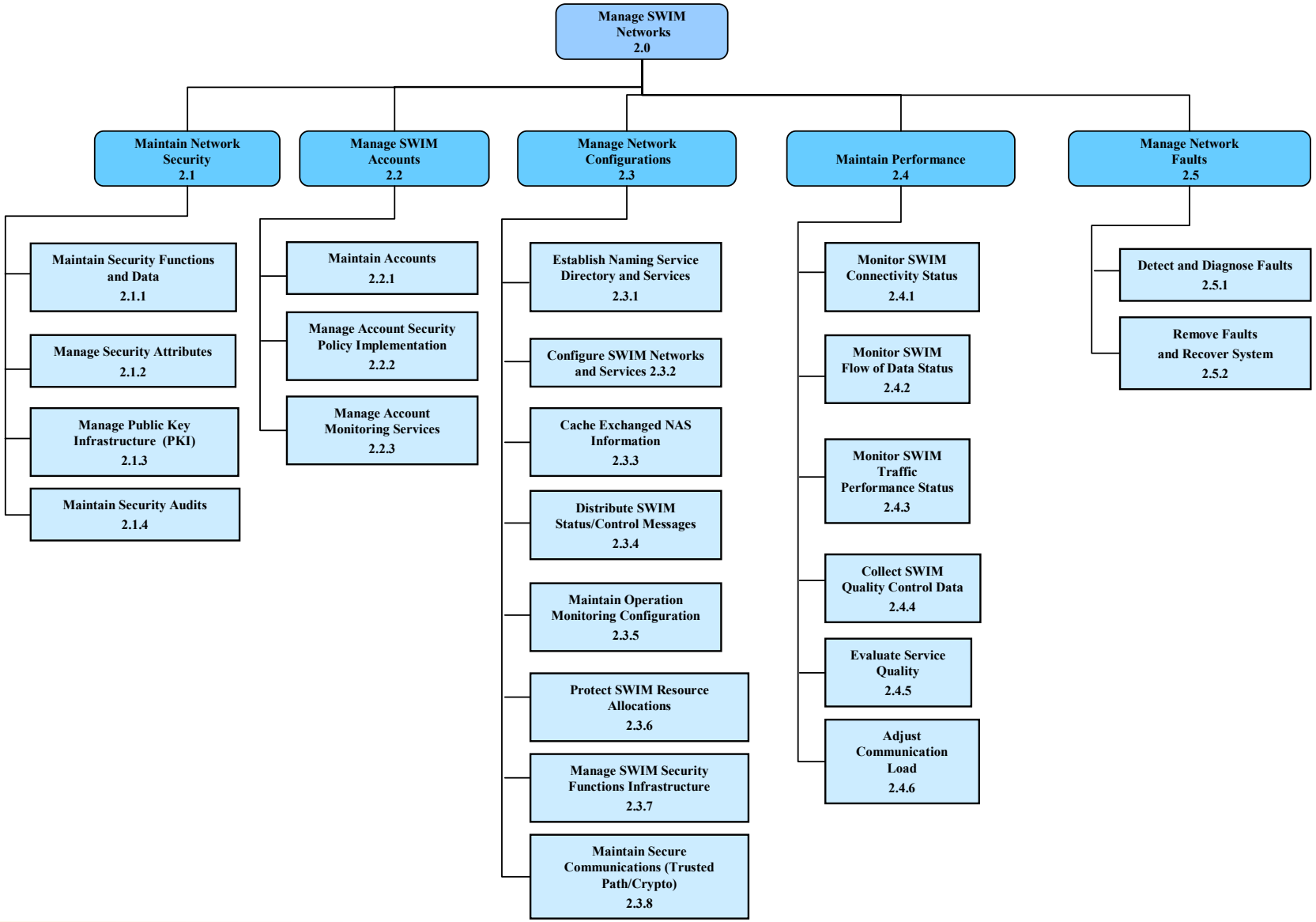
SWIM Physical Architecture Development Process



SWIM Functional Analysis Results



SWIM Functional Analysis Results (Cont'd)



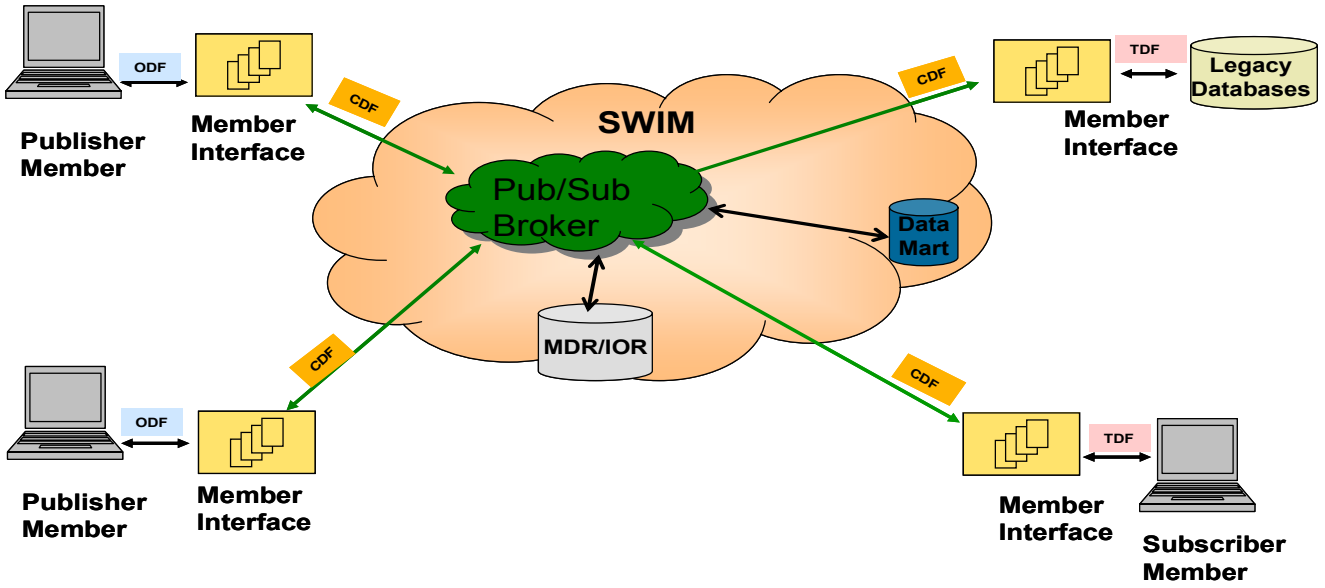
NAS Level Requirements for SWIM

- **NAS level requirements were developed for SWIM**
- **These are traceable to the RTCA NAS Concept of Operations and the SWIM Concept of Use**

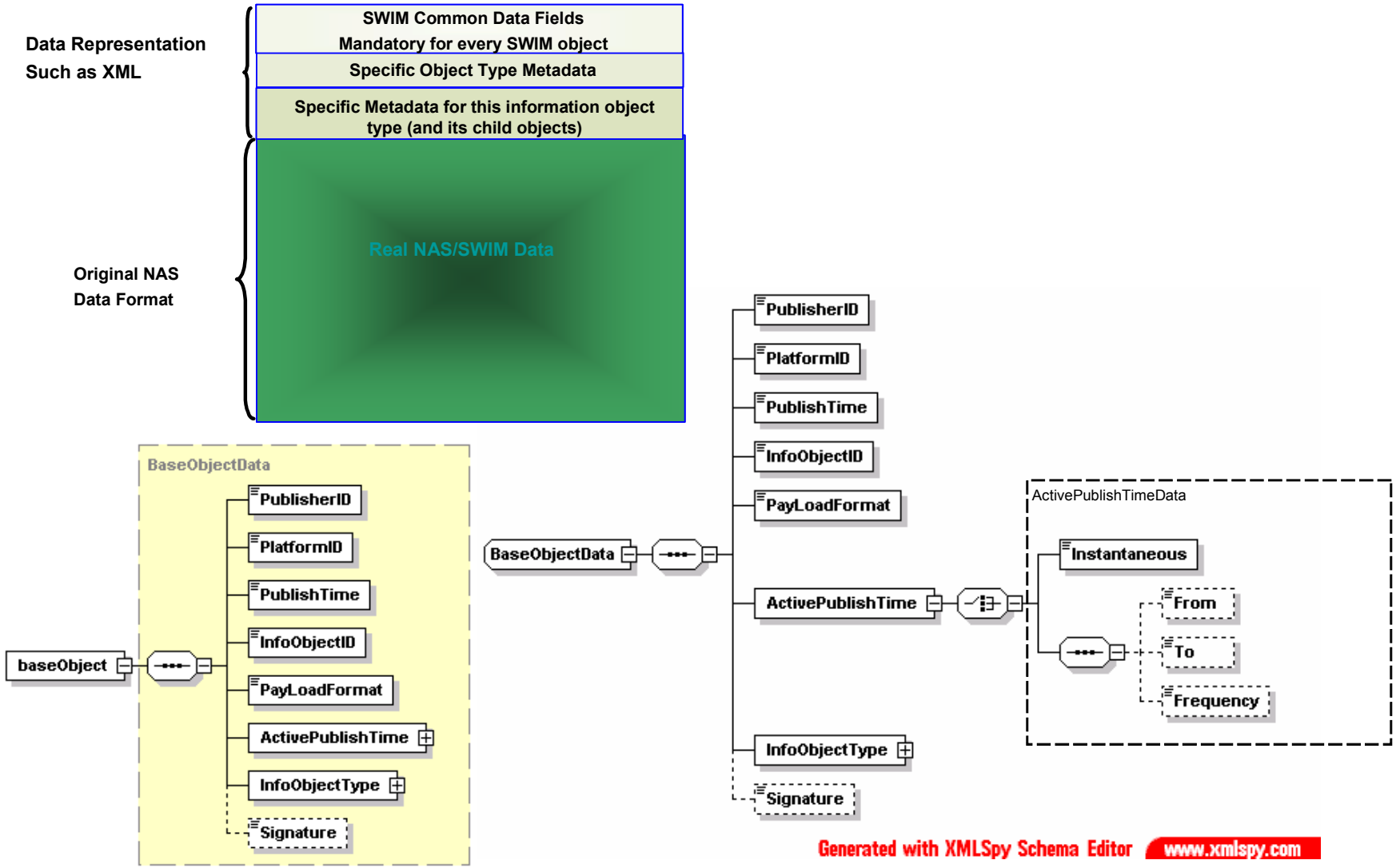
Num	NAS Level Requirement Statement
1	The NAS shall define standard "information access methods" for all SWIM members.
2	The NAS shall authenticate users and resources who attempt to access SWIM
3	The NAS shall assign different security levels to information to be exchanged [over SWIM]
⋮	⋮
34	The NAS shall provide account management [for SWIM]
35	The NAS shall provide fault management [for SWIM]
36	The NAS shall provide security functions [for SWIM]

SWIM Publish/Subscribe Architecture Concept

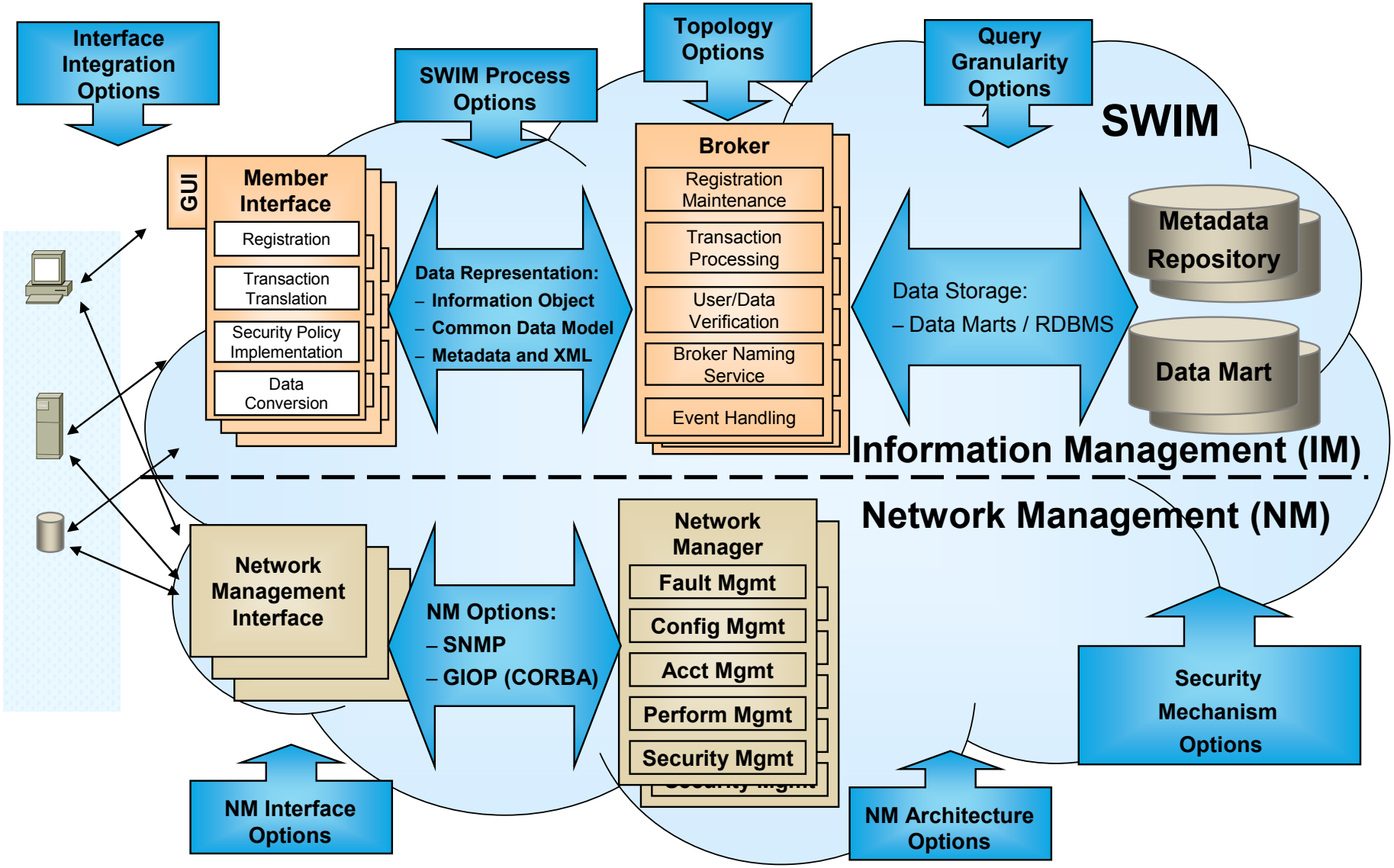
- **Strength:**
  - Full decoupling in ***Time*** **and** ***Space*** between publishers and subscribers
- **Benefits:**
  - Minimum impact on legacy systems
  - Automated capability to request/receive data
  - Fast and efficient data exchange
  - Adaptable to dynamic changes
  - Scalable solution



SWIM Data Concept

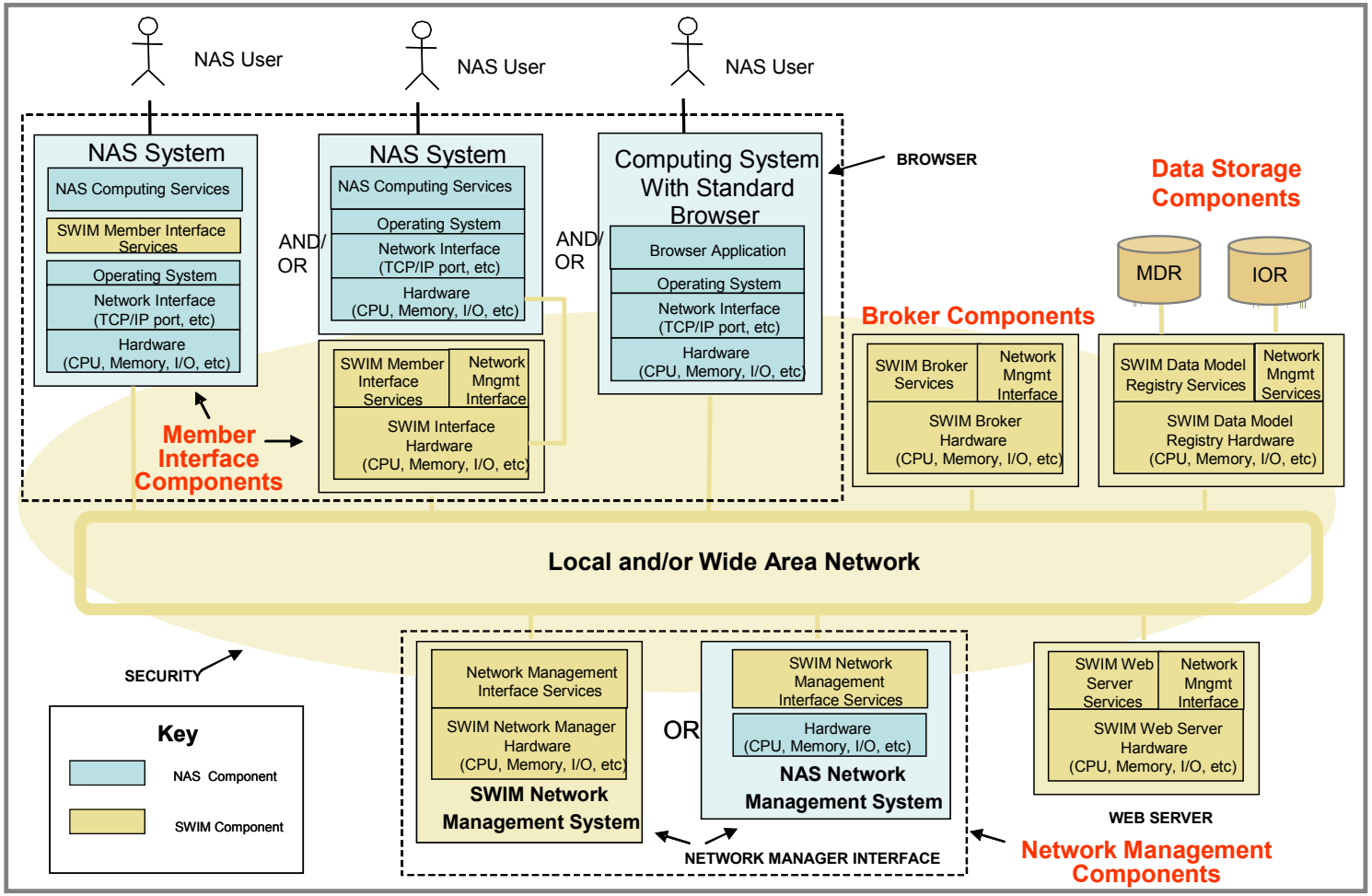


SWIM Architecture Design Issues



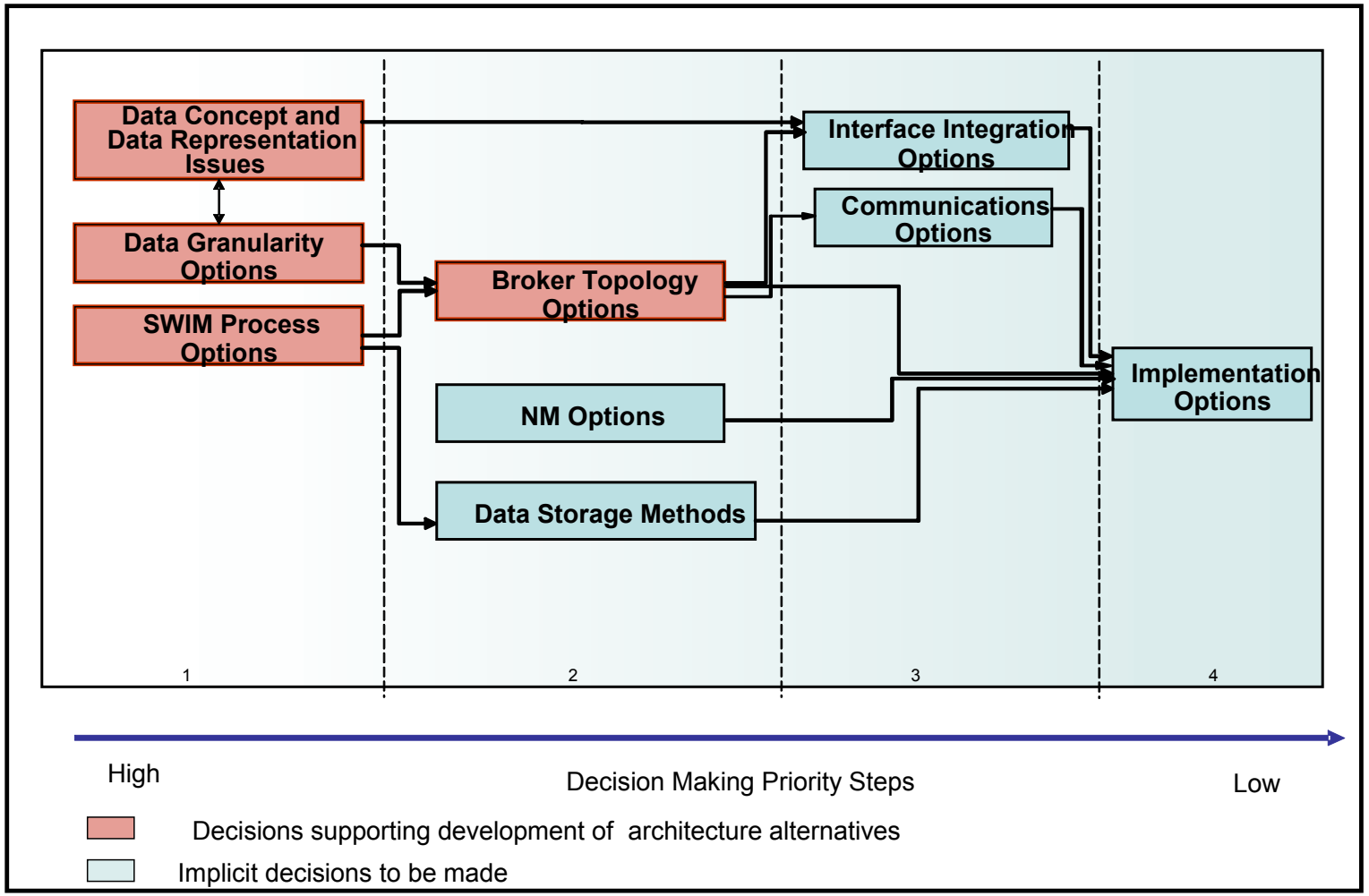
SWIM Physical Architecture Components

SWIM functions were mapped to the hardware and software components that constitute the SWIM physical architecture

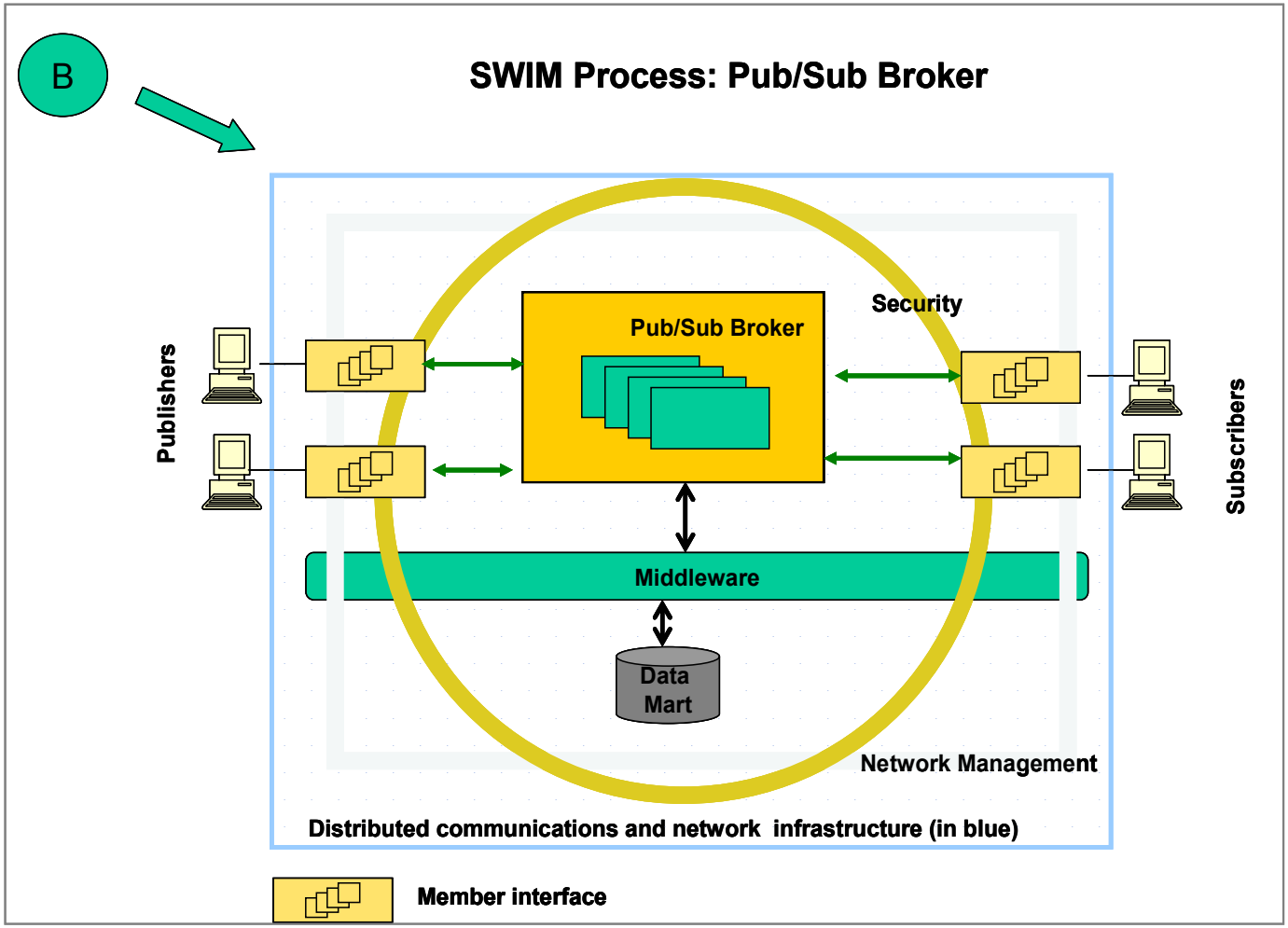


Alternative SWIM Physical Architectures

- **Based on the investigation of several design decision topics, three detailed candidate physical architectures for SWIM were identified**

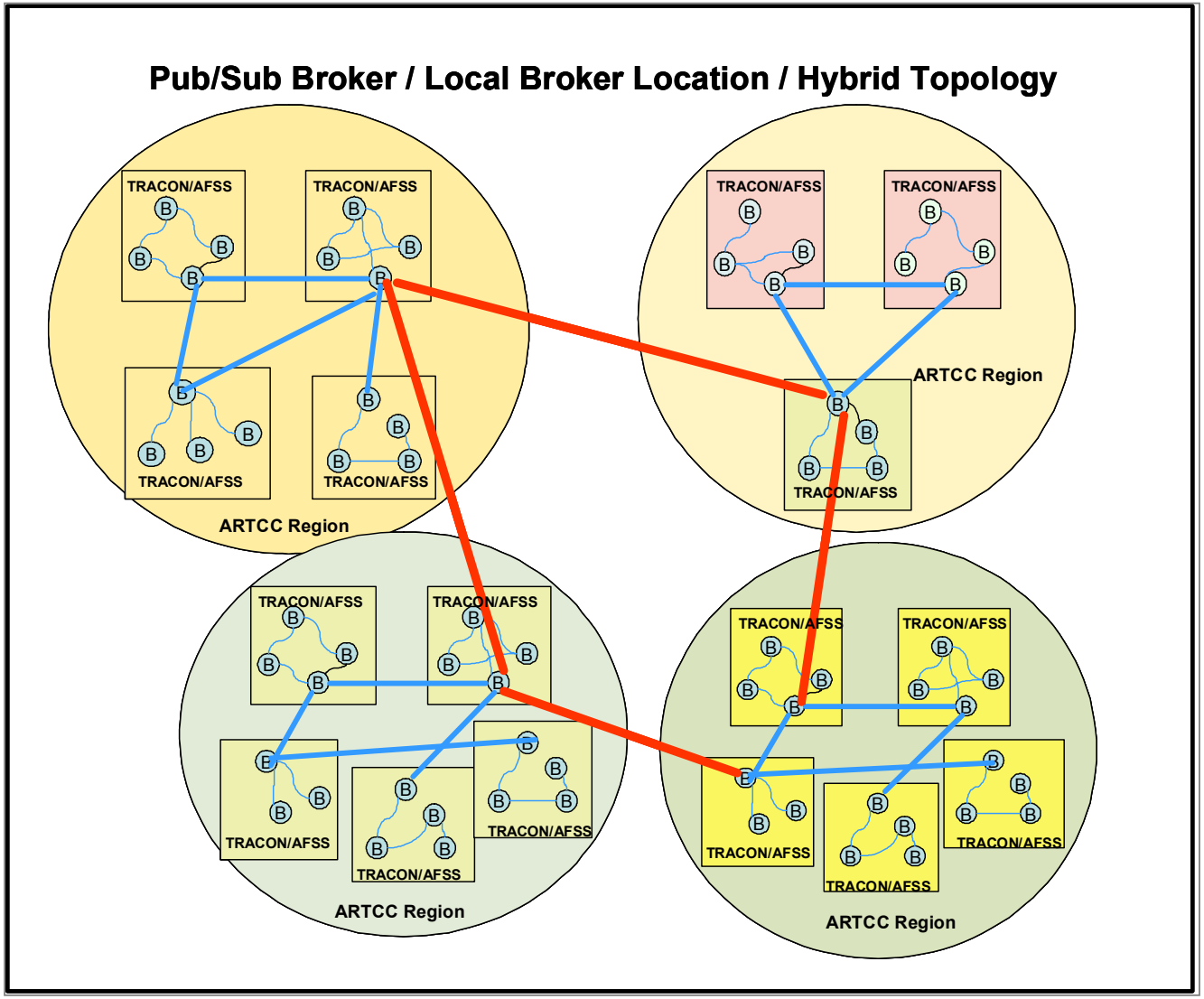


Architecture Candidate "A" Block Diagram



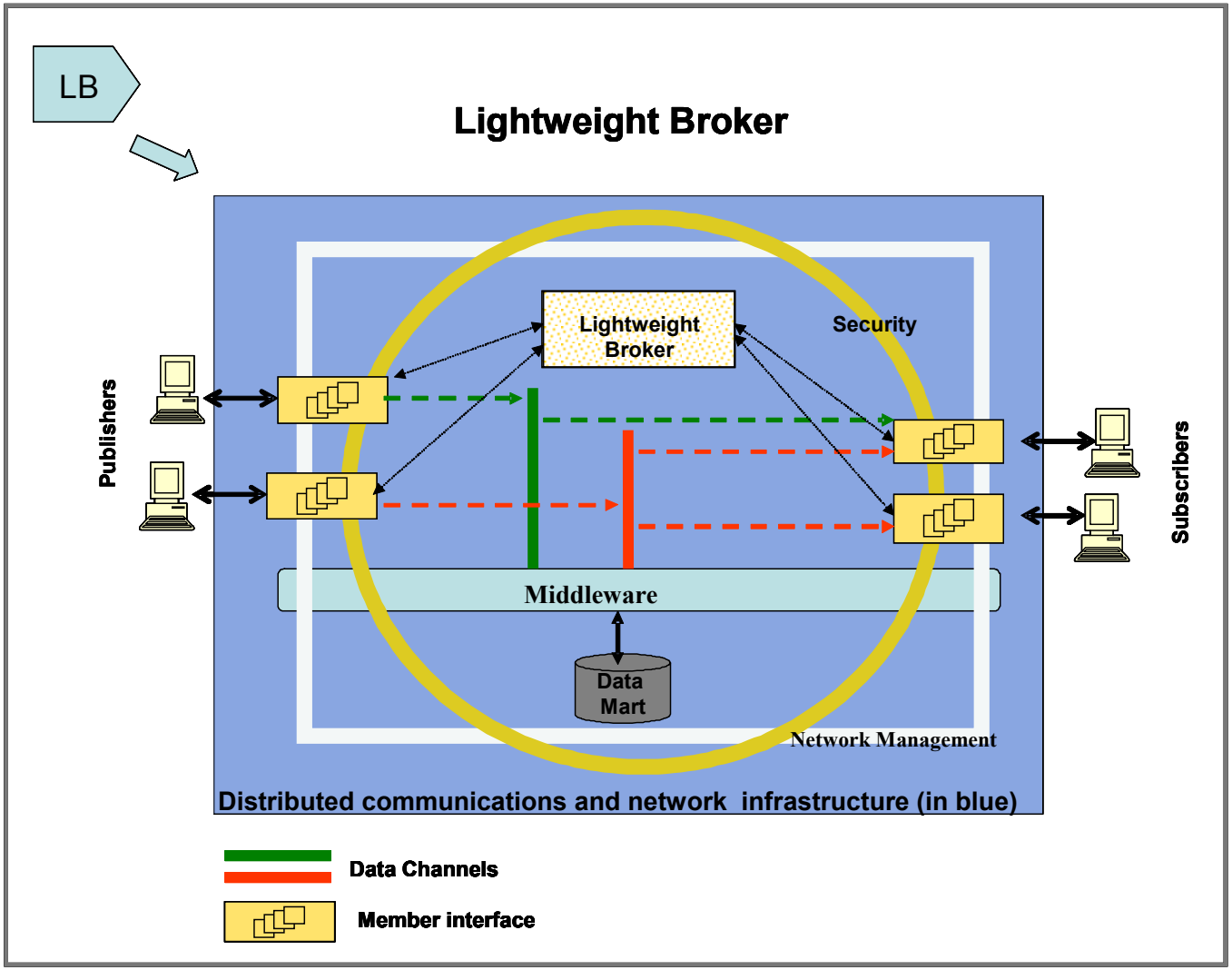
- Operations and interactions between publishers and subscribers are fully decoupled in space, time, and synchronization

Architecture Candidate "A" Broker Distribution



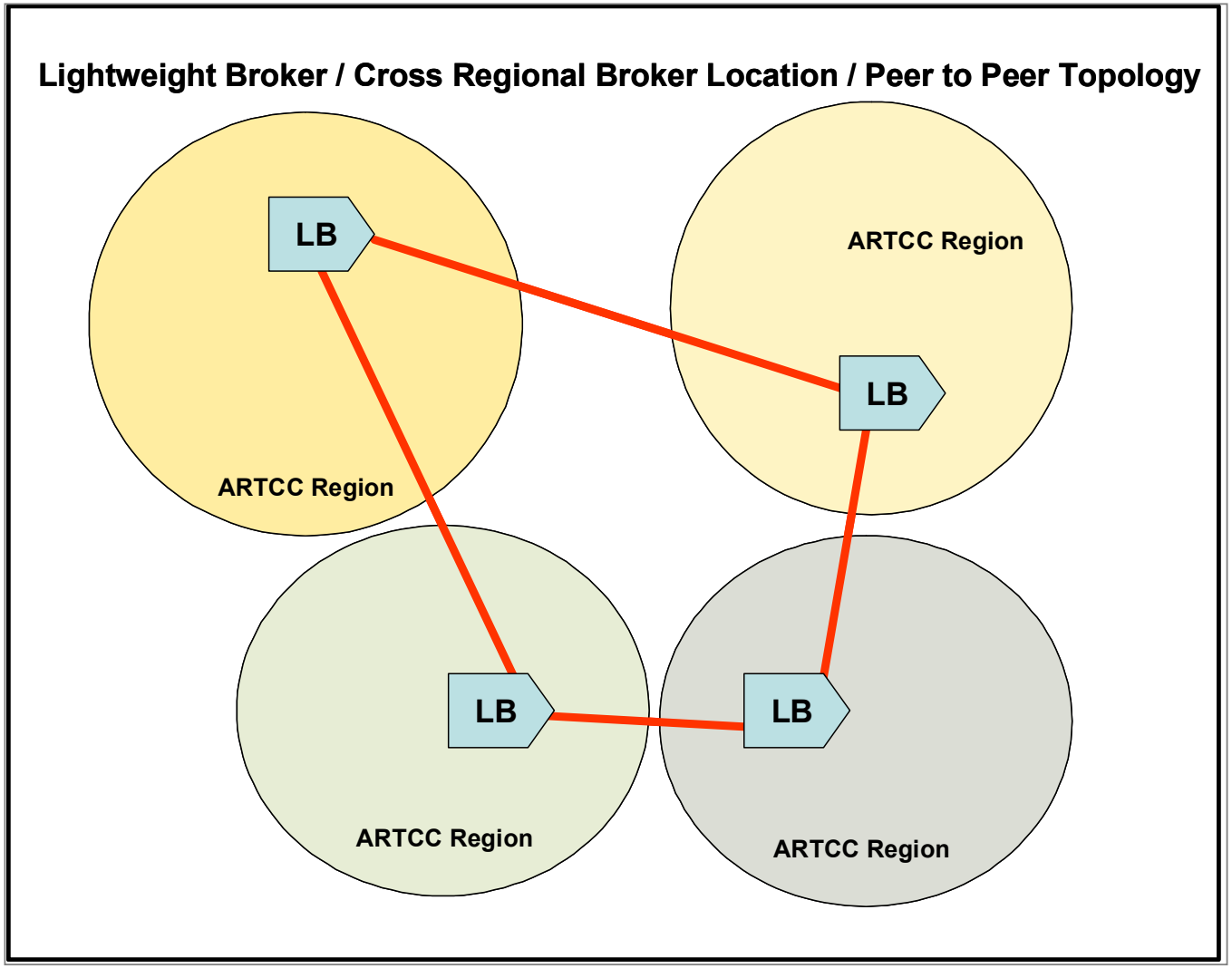
- Brokers are distributed throughout the NAS at ARTCCs and large facilities, TRACONs/AFSSs and ATCTs
- Brokers are connected via a hybrid topology (i.e. hierarchical within ARTCC regions/peer-to-peer between ARTCC regions)

Architecture Candidate "B" Block Diagram



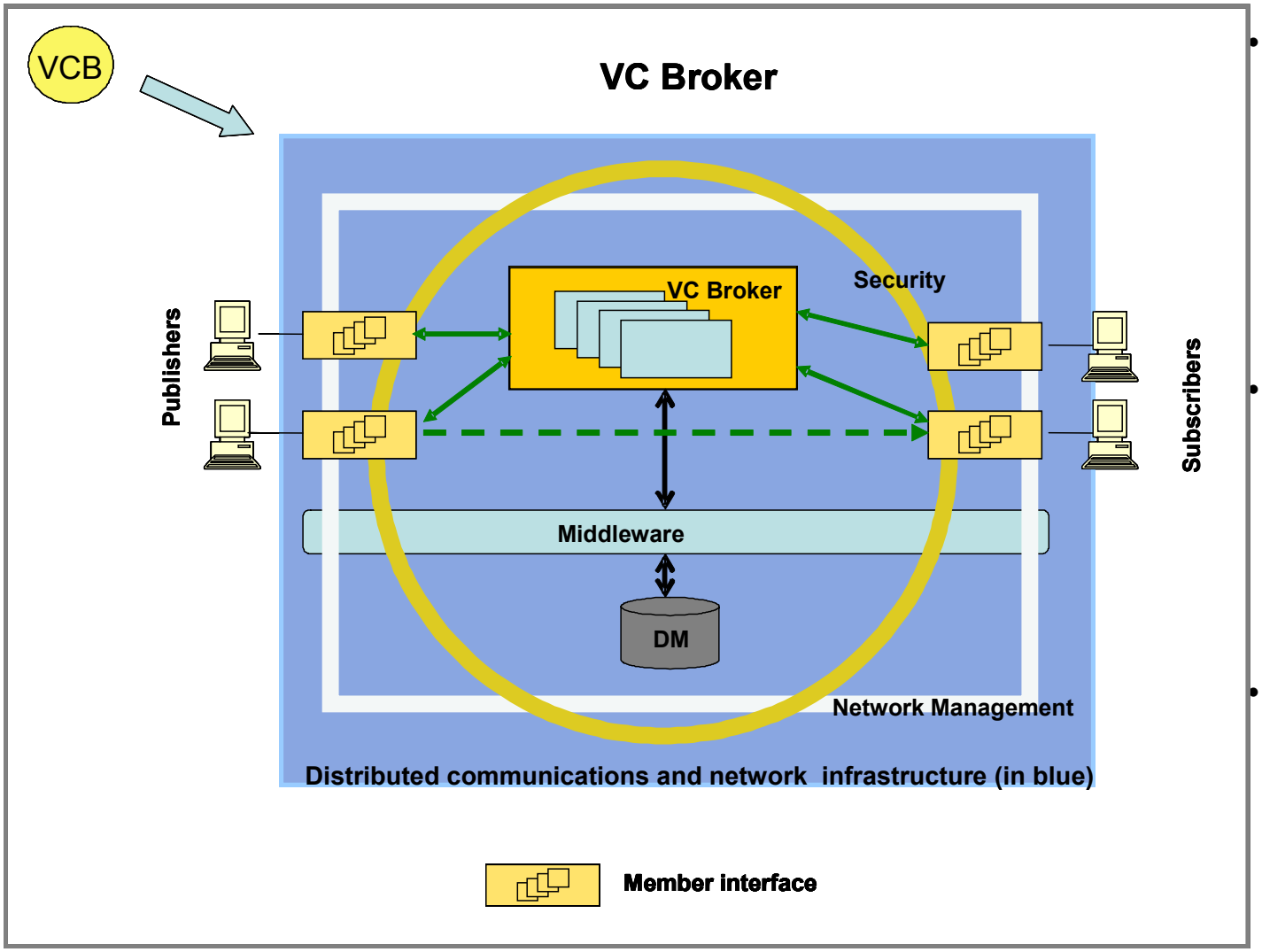
- Carries out a subset of Pub/Sub Broker functions and leaves some functions to traditional messaging mechanisms
- Operation and interactions between publishers and subscribers may not be fully decoupled in time, space and synchronization

Architecture Candidate "B" Broker Distribution



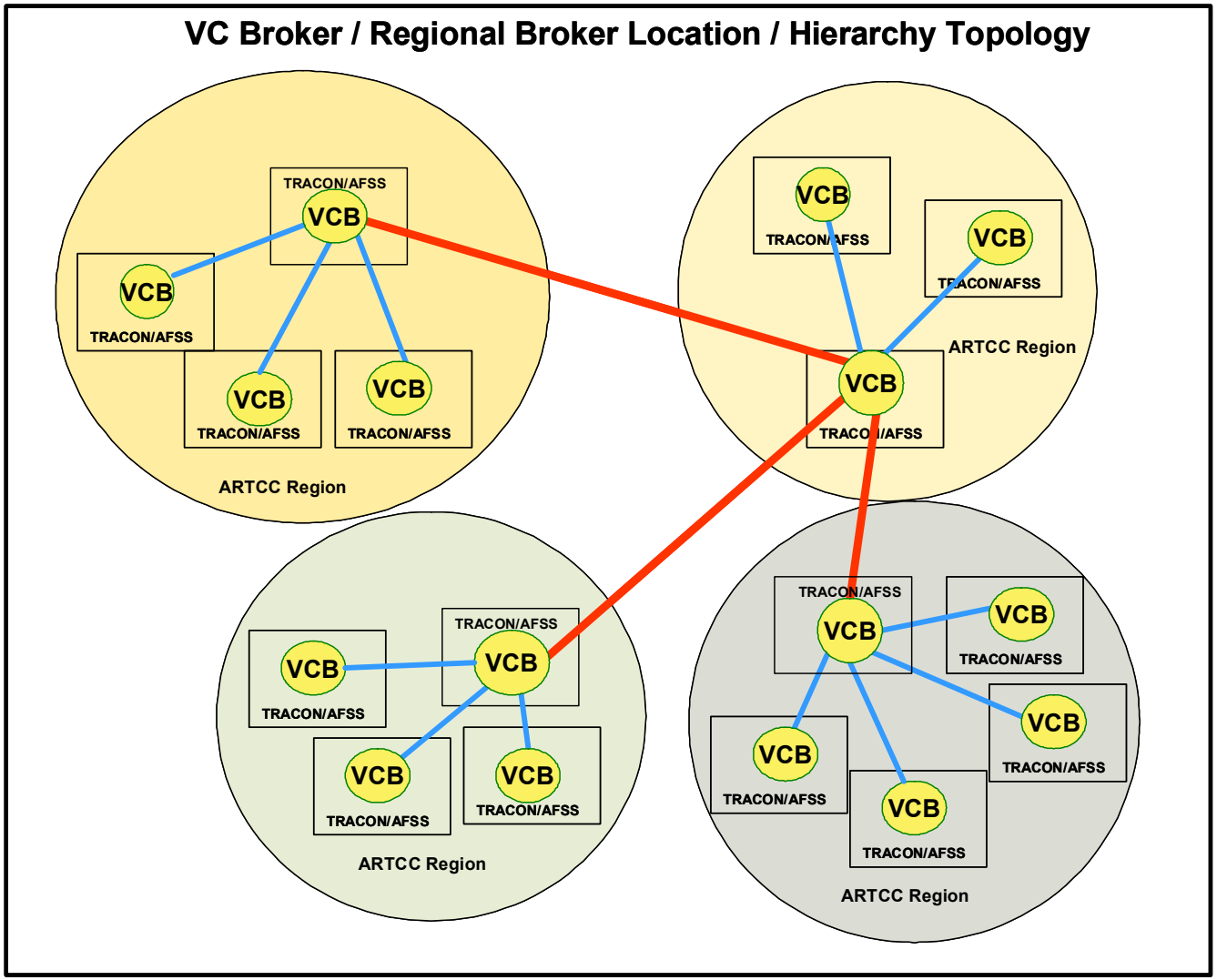
- Brokers for service setup are located at NAS ARTCCs and large facilities (e.g. ATCSCC)
- Brokers use peer-to-peer connections

Architecture Candidate "C" Block Diagram



- Information processing via a broker *or* virtual circuit between an information publisher and information subscriber
- Sets up a virtual connection (VC) for publishers and subscribers when dealing with stream data
- Operation and interactions between publishers and subscribers may not be fully decoupled in time, space and synchronization

Architecture Candidate "C" Broker Distribution



- Brokers are distributed throughout the NAS at ARTCCs and large facilities as well as to TRACONs/AFSSs
- Brokers are connected via a hierarchical topology

Architecture Comparison

- **Alternative architectures need to be evaluated as part of engineering model development and analysis**
  - Requirements compliance – how well does the architecture satisfy the NAS-level and function-level requirements of SWIM?
  - Complexity – the implementation and management complexity of the architecture
  - Availability of commercial solutions – how much of the architecture implementation can be supported by available COTS products and how much new development is needed?
  - Risk – what are the risks associated with the architecture implementation, e.g., security-related risk, performance-related risk, and implementation-related risk?
  - Schedule – Is the architecture too complex to be built to meet FAA schedules?
  - Cost – What are the costs associated with each architecture alternative? What is the cost/benefit ratio for each architecture alternative?

Summary

- **SWIM will provide the information sharing infrastructure to support evolving NAS operational concepts**
  - Enhanced situational awareness
  - Improved collaborative decision making
  - Free Flight
- **SWIM will provide information sharing functionality built on the FAA telecommunications infrastructure**
- **A publish/subscribe architecture concept for SWIM can meet information sharing needs across all ATC domains**